PATENT CLAIMS

1. A membrane module for separating off hydrogen, having a multiplicity of planar membrane cells, which each include two hydrogen-selective planar membranes that are each surrounded by a flat membrane frame, an air-permeable spacer layer that is arranged between the membranes in order to discharge permeate gas, and a feed frame that surrounds a feed space for reformate gas, all the membrane frames and feed frames having identical external dimensions and forming a stack with planar side faces, characterized in that the two membrane frames (16) of each membrane cell (2) have raised edges (22) which are directed toward one another and by means of which they are in contact with one another with the exception of at least one opening (24) toward one side face of the stack, in that the feed frame (18) is designed in such a way that, with the exception of openings (32, 34) toward side faces of the stack, it bears closely against the edges of the membrane frames (16) of two adjacent membrane cells (2), and in that the outer sides of all the membrane frames (16) and feed frames (18) are welded or soldered to one another in a gastight manner, but leaving clear the openings (24, 32, 34).

2. The membrane module as claimed in claim 1, characterized in that the membrane frames (16) include webs (28) which are directed toward one of the openings (32) in the feed frame (18).

3. The membrane module as claimed in claim 2, characterized in that the webs (28) extend in a radial distribution from the opening (32) in the feed frame (18) in the direction of a membrane edge.

4. The membrane module as claimed in one of the preceding claims, characterized in that the membrane frames (16) consist of a flat material into which the raised edges (22) and the at least one opening (24) and/or the webs (28) are stamped.

5. The membrane module as claimed in one of the preceding claims, characterized in that the membrane frames (16) consist of stamped metal sheet.

6. The membrane module as claimed in claim 5, characterized in that the two membrane

frames (16) of each membrane cell (2) are welded together at their raised edges (22).

7. The membrane module as claimed in one of the preceding claims, characterized in that the feed frames (18) are continuous annular strips which are narrower than the raised edges (22) of the membrane frames (16).

8. The membrane module as claimed in claim 7, characterized in that the openings (32, 34) in the feed frames (18) are recesses in the strips.

9. The membrane module as claimed in one of the preceding claims, characterized in that the feed frames (18) consist of metal.

10. The membrane module as claimed in claim 6 and claim 9, characterized in that the membrane frames (16) and the feed frames (18) are welded together.

11. The membrane module as claimed in claim 10, characterized in that passages are welded to the side faces of the stack and in each case connect corresponding openings (24) in the membrane frames (16) and/or openings (32, 34) in the feed frames (18) to one another and to the outer side.

12. The membrane module as claimed in one of the preceding claims, characterized in that membrane cells (2) are arranged on the topmost and bottommost feed spaces (8) of the stack, in each case in the following order: a membrane frame (16) with installed membrane (4), a spacer layer (6) and an end plate (14).

13. The membrane module as claimed in one of the preceding claims, characterized in that the external dimensions of the membrane frames (16), of the feed frames (18) and/or of the end plates (14) are formed by a rectangle with rounded corners.

14. A method for producing a membrane module for separating off hydrogen, in which a multiplicity of planar membrane cells are stacked on top of one another and connected to one

another, each membrane cell being constructed from two hydrogen-selective, planar membranes that are each surrounded by a flat membrane frame, an air-permeable spacer layer that is arranged between the membranes in order to discharge permeate gas, and a feed frame that surrounds a feed space for reformate gas, all the membrane frames and feed frames having identical external dimensions and being assembled to form a stack with planar side faces, characterized in that the two membrane frames (16) of each membrane cell (2) are designed with raised edges (22) which are directed toward one another and are placed on top of one another by means of the edges, the raised edges (22) being designed in such a way that at least one opening (24) toward a side face of the stack is left clear, in that the feed frame (18) is designed in such a way that with the exception of openings (32, 34) toward side faces of the stack it fits tightly onto the edges (22) of the membrane frames (16) of two adjacent membrane cells (2), and in that the outer sides of all the membrane frames (16) and feed frames (18) are welded or soldered to one another in a gastight manner, but leaving clear the openings (24, 32, 34).

15. The method as claimed in claim 14, characterized in that the membrane frames (16) are provided with webs (28) which are directed toward one of the openings (32) in the feed frame (18).

16. The method as claimed in claim 15, characterized in that the webs (28) are designed in such a way that they extend in a radial distribution from the opening (32) in the feed frame (18) in the direction of a membrane edge.

17. The method as claimed in one of claims 14 to 16, characterized in that the membrane frames (16) are produced from a flat material into which the raised edges (22) and the at least one opening (24) and/or the webs (28) are stamped.

18. The method as claimed in one of claims 14 to 17, characterized in that the membrane frames (16) are stamped from sheet metal.

19. The method as claimed in claim 18, characterized in that the two membrane frames (16) of each membrane cell (2) are welded together at their raised edges (22).

20. The method as claimed in one of claims 14 to 19, characterized in that the feed frames (18) are continuous annular strips which are narrower than the raised edges (22) of the membrane frames (16).

21. The method as claimed in claim 20, characterized in that the openings (32, 34) in the feed frames (18) are formed by recesses in the strips.

22. The method as claimed in one of claims 14 to 21, characterized in that the feed frames (18) are made from metal.

23. The method as claimed in claim 18 and claim 22, characterized in that the membrane frames (16) and the feed frames (18) are welded together.

24. The method as claimed in claim 23, characterized in that passages are welded on to the side faces of the stack and in each case connect corresponding openings (24) in the membrane frames (16) and/or openings (32, 34) in the feed frames (18) to one another and to the outer side.

25. The method as claimed in one of claims 14 to 24, characterized in that membrane cells (2) are arranged on the topmost and bottommost feed spaces (8) of the stack, in each case in the following order: a membrane frame (16) with installed membrane (4), a spacer layer (6) and an end plate (14).

26. The method as claimed in one of claims 14 to 25, characterized in that the external dimensions of the membrane frames (16), of the feed frames (18) and/or of the end plates (14) are formed by a rectangle with rounded corners.